

## Functions and Folktales

### Brief Overview:

Students are introduced to the rules and functions of algebra through a surprising media: folktales. Students will be exposed to the inconsistencies of human nature through Asian folktales, while understanding the consistency that exists in the mathematical world of algebra. Through a variety of interactive means, students will identify the patterns prevalent in functions tables of both increasing and decreasing values. Lastly, students will create their own function table following two-step operations.

### NCTM Content Standard/National Science Education Standard:

Understand patterns, relations, and functions.

- Describe, extend, and make generalizations about geometric and numeric patterns;
- Represent and analyze patterns and functions, using words, tables, and graphs.

### Grade/Level:

Grades 4-5

### Duration/Length:

Three lessons- 60 minutes per lesson

### Student Outcomes:

#### Maryland Voluntary State Curriculum

#### Standard 1.0 Knowledge of Algebra, Patterns, and Functions

Students will algebraically represent, model, analyze, or solve mathematical or real-world problems involving patterns or functional relationships.

##### A. Patterns and Functions

1. Students will identify, describe, extend, and create numeric patterns and functions:
  - a. Students will interpret and write a rule for a one-operation (+, -,  $\times$ ,  $\div$  with no remainders) function table.
  - b. Students will create a one-operation ( $\times$ ,  $\div$  with no remainders) function table to solve a real world problem.
  - c. Students will describe the relationship that generates a one-operation rule.
  - d. Students will apply a given two operation rule for a pattern.

**Materials and Resources:**

- Two of Everything by Lily Toy Hong
- Brown paper bags
- Number block counters
- One Grain of Rice: A Mathematical Folktale by Demi
- Bags of Kidney beans
- Calculators
- Overhead/ Visualizer
- Construction paper
- Scissors
- Markers
- Summative Assessment

**Development/Procedures:****Lesson 1****Pre-Assessment**

- Students will complete three problems that address various function rules.
- Students will evaluate patterns and functions. See Student Resource 1, “Plug It In Pre-Assessment,” and Teacher Resource 1, “Plug It In Pre-Assessment Guide.”

**Launch**

- Explore the book, Two of Everything, by Lily Toy Hong through an interactive read aloud.
- Introduce functions and input/output rules.
- Informally assess student knowledge of the relationship between the input number, the function rule, and the output number.

**Teacher Facilitation**

- Introduce and model concept of solving algebraic equations.
- Assemble six “Mystery Bags” to distribute to the class. See Teacher Resource 2, “Mystery Bags”. Students will break into groups of four and receive one “Mystery Bag” per group. Student groups will collaborate to solve the mystery question by using the hints supplied on each bag.
- Students will present answers to the whole group, explaining how they reached their answers.
- Open discussion on the difference in outcomes based on the differences of rules.

**Student Application**

Students will construct an increasing bar graph by using the missing number rule.

- Students will complete a function table using the rule “times 4”.

- Students will organize the data from the in- and-out table from least to greatest.
- Students will plot the data by constructing a bar graph. See Student Resource 2, “Function Table” and Teacher Resource 3, “Function Table Guide” for answer key.

### **Embedded Assessment**

- Student work will be informally assessed through a teacher “walk-about.”
- Students will answer BCR (Student Resource 3, “Let It Grow Assessment” and Teacher Resource 4 “Let It Grow Assessment Guide”) explaining the relationship between an input number and the outcome.

### **Reteaching/Extension**

- Students who have shown mastery of the skills incorporated in the lesson will work independently to solve various function tables.
- Students in need of additional support will work collaboratively using manipulatives to display outcomes presented by one-step function tables.

## **Lesson 2**

### **Pre-Assessment**

- Students will receive a completed bar graph that displays a pattern that decreases in value using a division rule.
- Students will complete BCR that addresses relationships and operations that produce a decreasing outcome. See Student Resource 4, “Downward Spiral” and Teacher Resource 5, “Downward Spiral Guide”.

### **Launch**

- Instruct whole class to line up, pretending to be waiting in line for a roller coaster ride. (This could be used as a means for putting students in groups.)
- Direct the students by playing the role of the ride conductor while instructing the students to play the roles of the passengers.
- Divide the line into groups of four as students approach the roller coaster. Instruct the proceeding groups to sit together on the floor, in their roller coaster car.
- Students will respond to questions relating to the separation of the class. For example: “What patterns occurred as the groups were formed? Which operation helped the ride conductor load the passengers? Can you find a rule for how we made our groups?”

### **Teacher Facilitation**

- Review pre-assessment BCR with the class. Reiterate the use of subtraction and division to create decreasing patterns in the outcome.
- Explain the input/output relationship as a pattern when a rule is applied consistently.

- Distribute small bags of kidney beans to each group of four students.
- Groups will receive a different amount of kidney beans in the bag. For example, group 1 will receive 16 kidney beans in all; group 2 will receive 20 kidney beans in all, etc.

### **Student Application**

Students will divide an amount of kidney beans by four group members to see a whole class pattern of decreasing outcomes.

- Students will divide kidney beans equally among all four group members.
- Student groups share the amount of kidney beans each member received.
- The whole class should record data in chart format. See Student Resource 5, “Kidney Bean”.
- Students discuss and decide which group members, based on the whole class data, received the most kidney beans each.

### **Embedded Assessment**

- Students complete BCR addressing why the input of a function table is just as important as the rule. Students use calculators to solve a function table. See Student Resource 6, “Book Assessment” and Teacher Resource 6, “Book Assessment Guide”.

### **Reteaching/Extension**

- Students needing further assistance will meet in a small group to receive direct instruction. Students will review two function tables, one that applies a rule of division, and one that applies a rule of subtraction.

## **Lesson 3**

### **Pre-Assessment**

- Students will receive a completed function table that incorporates two operations. See Student Resource 7, “Guess My Rule” and Teacher Resource 7, “Guess My Rule Guide”.
- Students will need to determine the function rule.

### **Launch**

- Students play “Guess My Rule!” on the overhead/visualizer. “Guess My Rule!” game uses two operations.

### **Teacher Facilitation**

- Facilitate discussion by asking, “Do all function tables have to go in order from least to greatest, or from greatest to least, to follow a rule?”
- Introduce and model the construction of “Guess My Rule!” game.
- Distribute construction paper, scissors, and markers.
- Partner students and spread out around the classroom.
- Instruct partners to keep their rule a secret.

**Student Application**

Students create “Guess My Rule” playing board with a partner using two operations. Use Teacher Resource 8 as a guide.

- Students will cut and fold construction paper into “Guess My Rule” playing board format.
- Partners brainstorm a possible rule and accompanying table on scrap paper before completing “Guess My Rule” playing board with a marker.

**Embedded Assessment**

- Partners trade playing boards with another pair of students. Students have 5 minutes to solve the rule of the table.
- Students continue to switch playing boards as time allows.

**Reteaching/Extension**

- Students needing further assistance receive direct instruction by playing “Guess My Rule” in a small group.
- Students showing proficiency while playing game complete three more slots on the table, following the rule to create their own numbers.

**Summative Assessment:**

Students will complete an assessment (Student Resource 8, “Summative Assessment”) consisting of three selected response questions and one constructed response item. The questions will address the concepts taught: patterns and functions, and will be used to measure student proficiency. See Teacher Resource 8 “Summative Assessment Guide”.

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## **Appendix A: Teacher Resources**

Functions and Folktales  
Plug It In Pre-Assessment Guide



1.  $7 \times \underline{3} = 21$
- a) 2      b) 3      c) 5      d) 4

2. Examine the table below, what is the rule?

**Multiply 4**

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In	Out
2	8
4	16
6	24

3. Richard is making cotton candy. He needs 3 spoons of sugar to make 1 bag of candy. How many spoons will he need to make 5 bags of candy. Complete the chart the chart below.

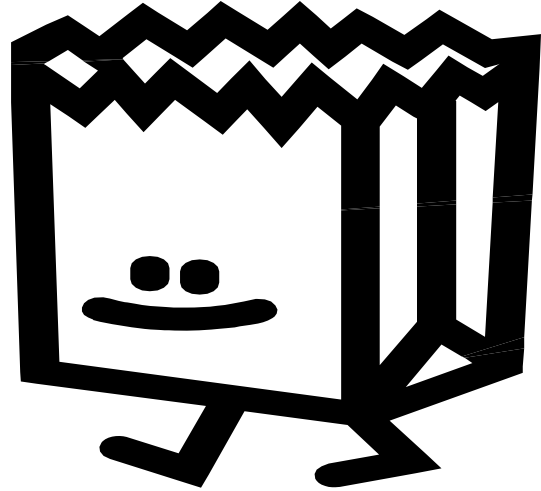
<b>Bags of Candy</b>	1	2	3	4	5
<b>Spoons of Sugar</b>	3	6	9	12	15

Richard will need 15 spoons of sugar to make 5 bags of cotton candy.

Teacher Resource 1

## Mystery Bag Activity

### Lesson 1



Materials:     Brown paper bags  
                 Number block  
                 Construction Paper and markers

Preparation:

1. Using construction paper and markers cut the paper into fourths. On each slip of paper write a series of rules for an equation.

Example-

Six times what number is equal to forty-two

2. Place the number block of the answer into a brown paper bag.
3. Staple the slip of construction paper to the front of the bag and fold .
4. Make as many “mystery bags” as groups you would like to have.

Instructions:

Each group will work cooperatively to figure out what number is inside of the bag. The group must explain how they reached their answer and how it would change if the rules on the bag were different.

\*Hint: To increase student understanding of mathematical operations use all the same numbers for the clues, but change the operations. Have the student explain how their answers were different and why.

Teacher Resource 2

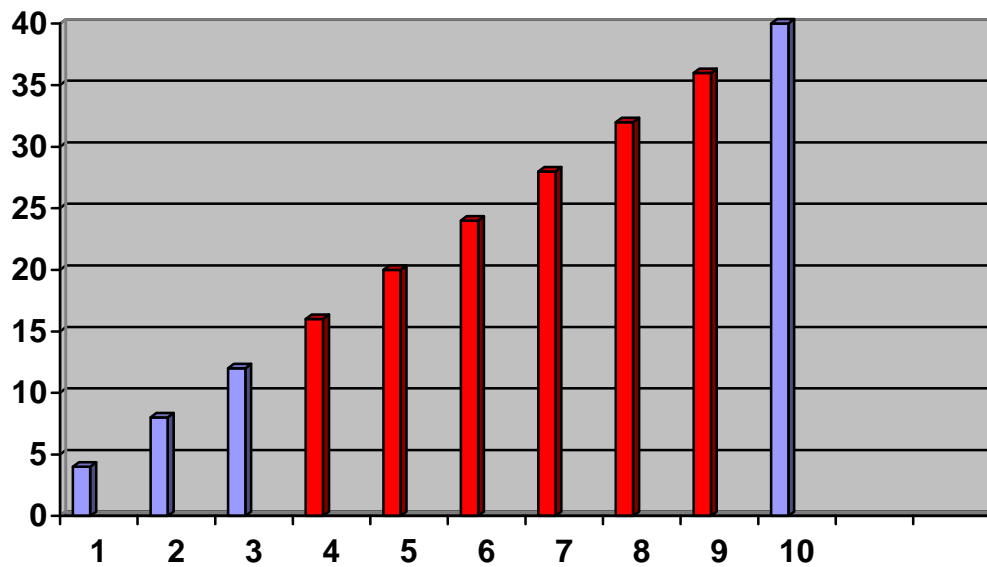


## Functions and Folktales

### Function Table

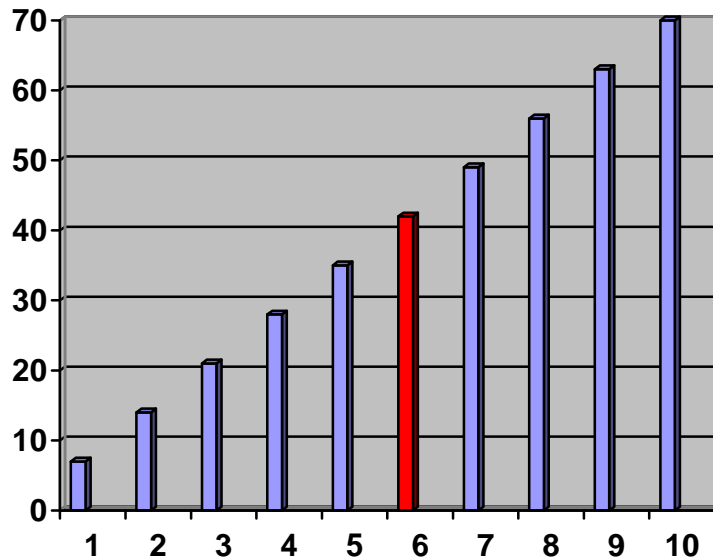
Identify and complete the pattern; then graph your results.

4, 8, 12, 16, 20, 24, 28, 32, 36, 40



Teacher Resource 3

Functions and Folktales  
Let It Grow Assessment Guide



1. Examine the above graph. Use what you know about function tables to fill in the bar above 6.
2. What is the rule of this graph? **multiple 7**

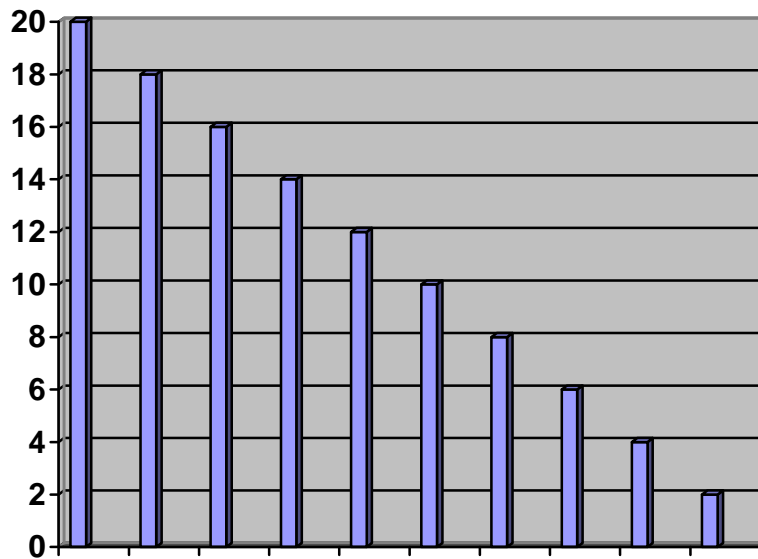
BCR

3. Using what you know about function tables and graphing trends, explain why your answer is correct.

**Sample Answer:** I noticed the pattern that the bars got larger as the number along the bottom increased. I know that  $10 \times 7 = 70$  and if you multiply each number on the bottom by 7, the number on the left is the product.  $6 \times 7 = 42$ , so I made my bar to stop at 42.

Teacher Resource 4

Functions and Folktales  
Downward Spiral Guide



1. Examine the above graph. Use what you know about function tables to determine the rule.

What is the rule of this graph? **divide by 2**

BCR

2. Using what you know about function tables and graphing trends, explain why your answer is correct.

**Sample Answer: If you divide the numbers on the left by the number on the bottom, each answer is two.**

ECR

3. What other operations could generate a decreasing graph such as this. Explain your answer.

**Sample Answer: Subtraction or division will generate a decreasing graph. This means that the starting number decreases as the pattern continues.**

Teacher Resource 5

Functions and Folktales  
Book Assessment Guide

Selected Response

1. Ms. Howell is reading a book that is 120 pages long. If she reads 30 pages each day, how long will it take her to read the entire book? Fill in the chart below to find your answer.

Days	Pages Read
1	30
2	60
3	90
4	120

- a) 10      b) 5      c) 4      d) 6

BCR

2. If she wanted to finish the book in 5 days, how many pages would she read each day?

24 pages each day

3. Ms. Howell wanted to read the author's notes at the end of the book, which are 7 pages long. Use what you know about numbers and patterns to explain how this changes her answer.

Sample Answer:

If Ms. Howell wanted to read the 7 extra pages,  $120 + 7 = 127$ , then she could read 25 pages each day and 26 pages for two days or she can read 25 each day and 2 on the sixth day. Which means that she would not be reading the same number of pages each day because 5 do not divide into 127 evenly.

$$25+25+25+25+25+2= 127$$

$$25+25+25+26+26= 127$$

Teacher Resource 6

Functions and Folktales  
Function Table with 2 Operations



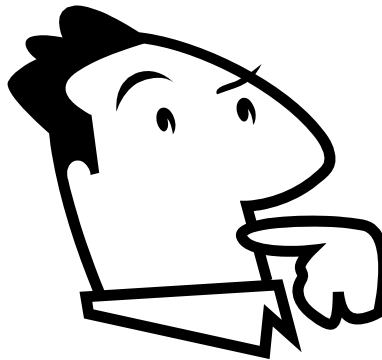
**“Guess My Rule!”**

<b>2</b>	<b>7</b>
<b>3</b>	<b>10</b>
<b>4</b>	<b>13</b>
<b>5</b>	<b>16</b>
<b>6</b>	<b>19</b>
<b>7</b>	<b>22</b>
<b>8</b>	<b>25</b>
<b>9</b>	<b>28</b>

**Rule: multiply by 3, add 1**

Teacher Resource 7

Guess My Rule Activity  
Lesson 3



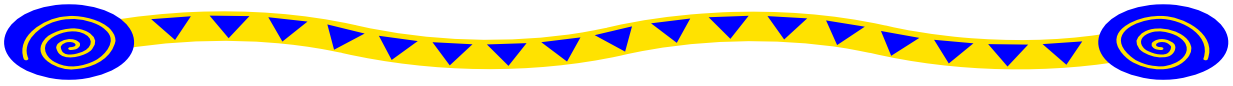
Materials:     Construction paper  
                 Scissor  
                 Markers

Instructions:

1. Fold construction paper on a “hot dog” (horizontal) fold two times,. Then unfold the paper.
2. Refold the paper on the “hot dog” fold once down the middle.
3. Using scissors, cut slits from the open in up to the folded line two inches apart across the bottom.
4. Unfold the paper and fold slits up or down to the center fold.
5. Use markers to write number patterns, one in each section under the flaps.
6. Students will cover numbers with flaps and reveal them one at a time as peers attempt to guess the rule the student used to make the pattern.

Teacher Resource 8

Functions and Folktales  
Summative Assessment



1.  $4 \times \underline{\quad} = 32$

a)  $2+1$

b)  $5+3$

c)  $7-2$

d)  $4+2$

2. Examine the table below, what is the rule?

Divide by 9

Fill in the blanks with numbers that follow the rule.

In	Out
63	7
9	1
36	4
45	5
18	2
27	3

3. The P.E. teacher, Mr. Cruz wants to plan a basketball game for the fourth grade class. His problem is that the 4<sup>th</sup> graders need to practice! But, there are not enough basketballs! He only has three basketballs. Groups of four students can practice with one ball. Complete the chart to find out how many basketballs are needed in the gym. HINT: There are 29 students in the class!

Number of Students That Can Practice	4	8	12	16	20	24	28	32
Number of Basketballs	1	2	3	4	5	6	7	8

8 basketballs are needed.

4. Use what you know about patterns, functions, and the table above to determine how many more basketballs Mr. Cruz will need to buy before the big game! Explain how you found your answer.

Mr. Cruz will need to purchase 5 more basketballs. The rule of the table is to divide by 4. I knew that 4 times 7 equaled 28, but the class was made up of 29 students. Instead of needing 7 basketballs, Mr. Cruz needs 8 basketballs in total for the extra student. Lastly, Mr. Cruz started with 3 basketballs. He needs a total of 8. I subtracted 3 basketballs from 8 basketballs and found out that he needs to buy 5 more basketballs.

5. Mr. Cruz developed a new way to practice. Now, five students can practice with only one basketball. How will your answer change? Explain.

If five students can practice with one basketball, then the rule of the table will be to divide by 5. The pattern will use multiples of 5 such as 5, 10, 15, 20, 25, and 30. Therefore, only 6 basketballs will be needed. Because  $6 - 3 = 3$  Mr. Cruz will only need to buy 3 basketballs.

Teacher Resource 9



## **Appendix B: Student Resources**

Functions and Folktales  
Plug It In Pre-Assessment



1.  $7 \times \underline{\quad} = 21$

- a) 2                      b) 3                      c) 5                      d) 4

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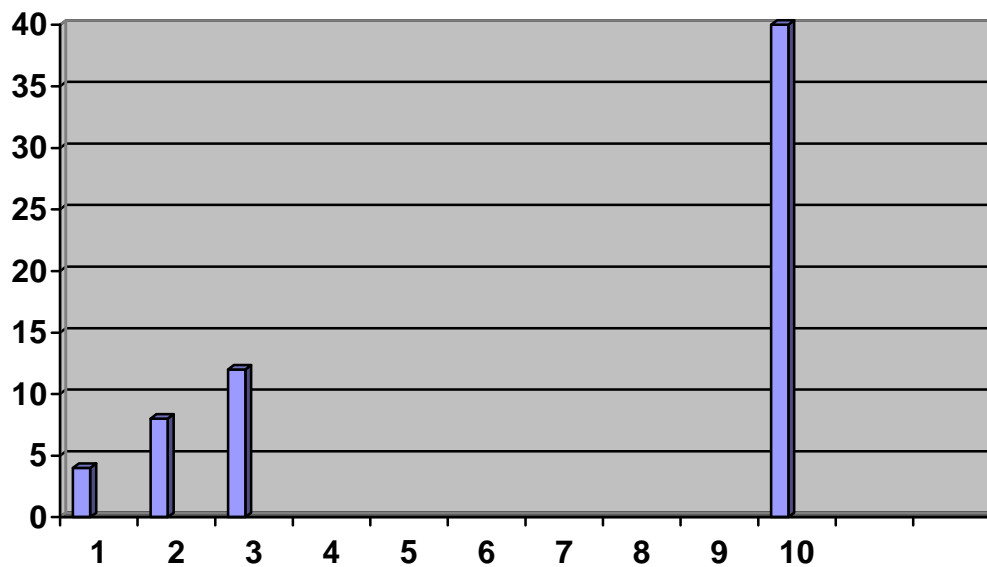
<b>Bags of Candy</b>	1	2	3		5
<b>Spoons of Sugar</b>	3	6		12	

Richard will need \_\_\_\_\_ spoons of sugar to make 5 bags of cotton candy.

Functions and Folktales  
Function Table

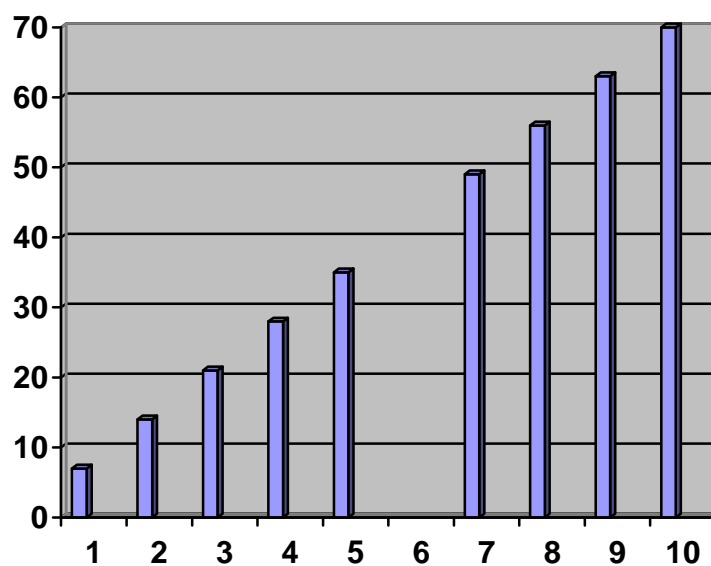
Identify and complete the pattern; then graph your results.

4, 8, 12, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_



Student Resource 2

Functions and Folktales  
Let It Grow Assessment



1. Examine the above graph. Use what you know about patterns to fill in the bar above 6.

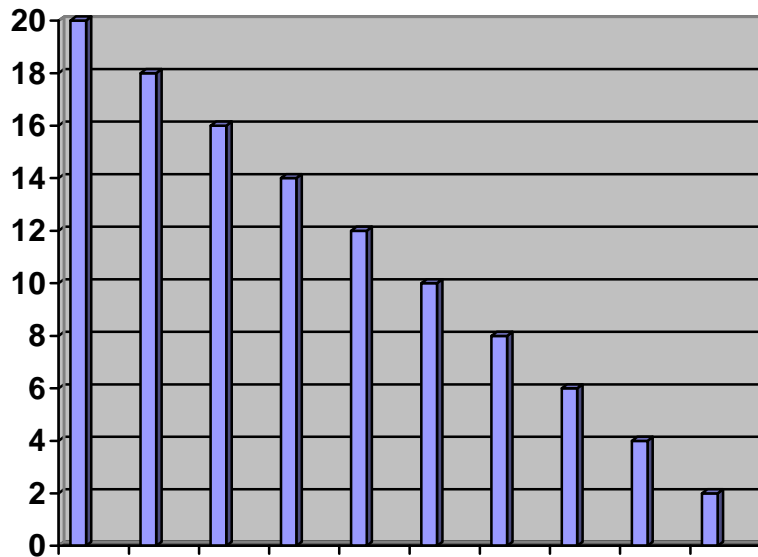
2. What is the rule of this graph? \_\_\_\_\_

BCR

3. Using what you know about function tables and graphing trends, explain why your answer is correct.

Student Resource 3

Functions and Folktales  
Downward Spiral Pre-Assessment



1. Examine the above graph. Use what you know about patterns to determine the rule.

What is the rule of this graph? \_\_\_\_\_

**BCR**

2. Using what you know about function tables and graphing trends, explain why your answer is correct.

**ECR**

3. What other operations could generate a decreasing graph such as this? Explain your answer.

Functions and Folktales  
Kidney Bean Activity Spreadsheet

Counting Beans



Group #	Total No. of Beans (IN)	No. of Beans per Student (OUT)

Student Resource 5

Functions and Folktales  
Book Assessment

Selected Response

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Days	Pages Read

a) 10

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d) 6

BCR

2. If she wanted to finish the book in 5 days, how many pages would she read each day?
3. Ms. Howell wanted to read the author's notes at the end of the book, which are 7 pages long. Use what you know about numbers and patterns to explain how this changes her answer.

Student Resource 6

Functions and Folktales  
Function Table with 2 Operations



**“Guess My Rule!”**

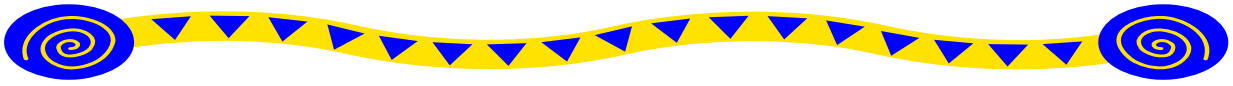
<b>2</b>	<b>7</b>
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<b>5</b>	<b>16</b>
<b>6</b>	<b>19</b>
<b>7</b>	<b>22</b>
<b>8</b>	<b>25</b>
<b>9</b>	<b>28</b>

**Hint: You must use two operations for the rule!**  
**(Addition, Subtraction, Multiplication, and Division)**

Student Resource 7



Functions and Folktales  
Summative Assessment



1.  $4 \times \underline{\quad} = 32$

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b)  $5+3$

c)  $7-2$

d)  $4+2$

2. Examine the table below, what is the rule?

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Fill in the blanks with numbers that follow the rule.

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	5
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27	

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Number of Students That Can Practice	4	8	12					
Number of Basketballs	1	2	3	4				

\_\_\_\_\_basketballs are needed,

4. Use what you know about patterns, functions, and the table above to determine how many more basketballs Mr. Cruz will need to buy before the big game! Explain how you found your answer.

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5. Mr. Cruz developed a new way to practice. Now, five students can practice with only one basketball. How will your answer change? Explain.

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Student Resource 08

